

# Low Voltage Circuit Breaker Testing

## Why Test Circuit Breakers?

They fail. A survey by Hartford Insurance Company found that air circuit breakers represent 19.5% of electrical power system failures. Test results on circuit breakers by NETA (InterNational Electrical Testing Association) firms show over a 15% failure rate.

Defective circuit breakers can allow extensive damage, personnel injury, or make an outage more widespread when a fault occurs. They can also trip when they shouldn't causing expensive downtime.

There is no way to know if a circuit breaker will operate properly under fault or overload conditions unless it is tested, preferably by a primary injection test. (Refer to NEMA Standard AB 4 "Guidelines of Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.")

## How Do They Sense Overcurrent?

**Solid State Trips:** Current transformers send signals to a solid-state logic box or microcomputer which determines the tripping time. This technology is very precise, flexible, and reliable.

**Thermal/Magnetic:** A bimetallic release or solder pot is heated by load current for overload tripping. Instantaneous or short circuit tripping uses a core with a restraint spring. These methods are found in motor overloads and molded case circuit breakers.

**Electromechanical Trips:** Magnetic cores pull against oil dashpots or air diaphragms or mechanical flywheels to create time delay tripping on overloads. Core and spring units are found on instantaneous trips for low voltage air circuit breakers.

## Why Do They Fail Or Fail?

Current sensors fail because they are mis-wired or broken, or solid state components have failed or are incorrectly programmed. Trip linkages fail because dust, hardened grease, corrosion, misalignment or frozen or broken parts prevent operation (even though the breaker may be operated manually and therefore appear to operate properly). The current-carrying parts and main contacts fail because they have been damaged by fault interruption or operating springs have fatigued such that they no longer provide adequate opening or closing force or because internal connection have become loose. The case or insulation fails because it has cracked or been damaged. Common failures include: dashpots leaking, spurious tripping, linkage not adjusted, no tripping at all, broken cases exposing live parts, loose internal connections, defective or broken parts, metal fatigue, age, overuse or misapplication.

## How Should They Be Tested?

Solid-state units can be tested by either secondary or primary current injection. The secondary injection test is performed using a specially designed power supply unit. It should be noted that the secondary injection method only tests the solid-state trip unit logic and does not test the current sensors, wiring, or the breaker current handling components. Most solid-state trip units have terminal blocks that are equipped with test plug terminals for making the calibration test. The test set allows checking of the solid-state trip unit operation without using primary current. The test set will pass enough current to check any desired calibration point. The breaker must be de-energized before checking the operation of the solid-state trip units. If the test set shows that the solid-state trip unit is not functioning properly, the trip unit should be replaced.

The primary current injection method is usually preferred because it is expected that this method verifies that the sensors and wiring, as well as the conduction path in the breaker. It is recommended that the primary injection test be performed simultaneously on all three phases when testing breakers with solid state-trip units. If three phase primary injection testing is not practical, then it is recommended that the sensors and wiring should be tested separately. This testing should be performed per NETA and NEMA procedures in accordance with manufacturer's recommendations.

- Measure contact voltage drop at rated current, (finds loose connections, improper contact pressure, or damaged main contacts).
- Test instantaneous trip function with pulse or higher currents until trip occurs, (tests short circuit protection capability).
- Measure overload tripping time at 300% rated current.
- Check mechanical operation. Inspect for broken parts.
- Test operation of ground fault, short time pickup and delay, shunt trips, undervoltage releases, alarm functions, electrical spring charging mechanism, etc.
- Check insulation resistance phase-to-phase and phase-to-ground, closed and across open contacts.

## Special Considerations

- Testing is recommended at start-up and every three years there after
- Circuit breaker must be de-energized to perform test
- For primary current injection testing, a power source capable of supplying 100 amps at 208 or 480 volts is required to power the test set



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